Climate Change and Utah

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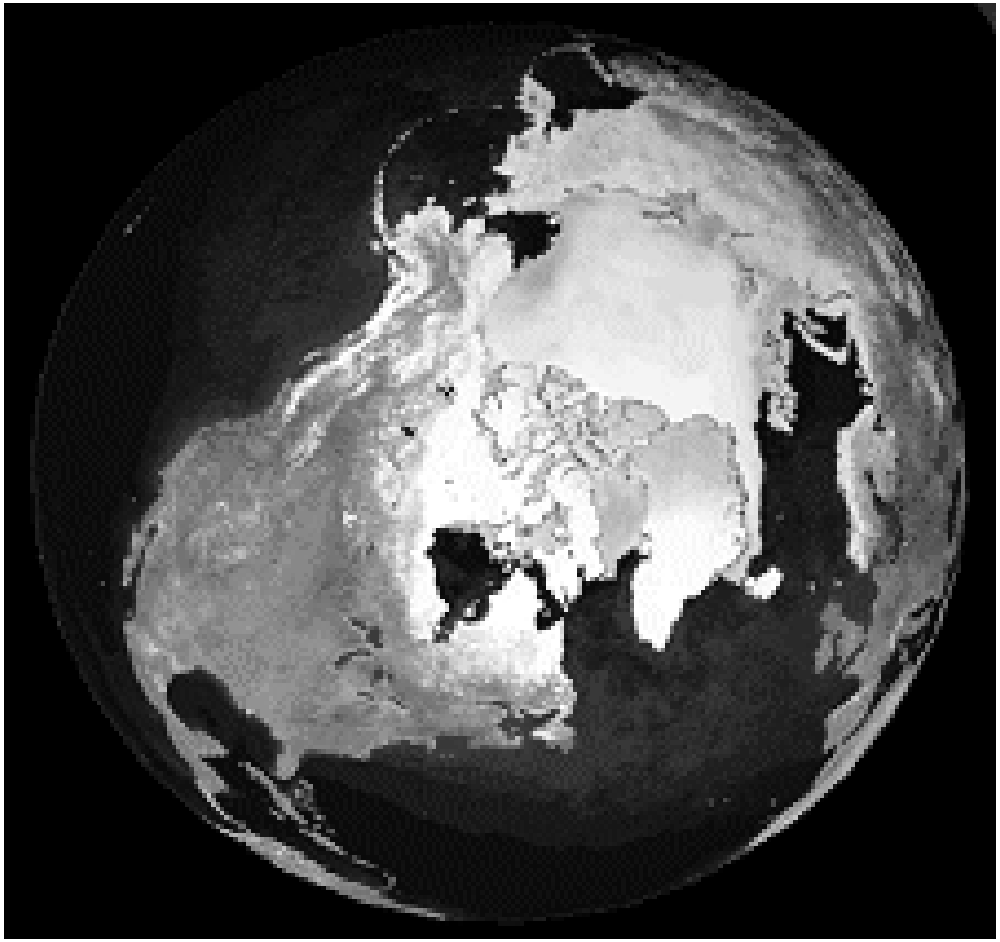
Our Changing Atmosphere

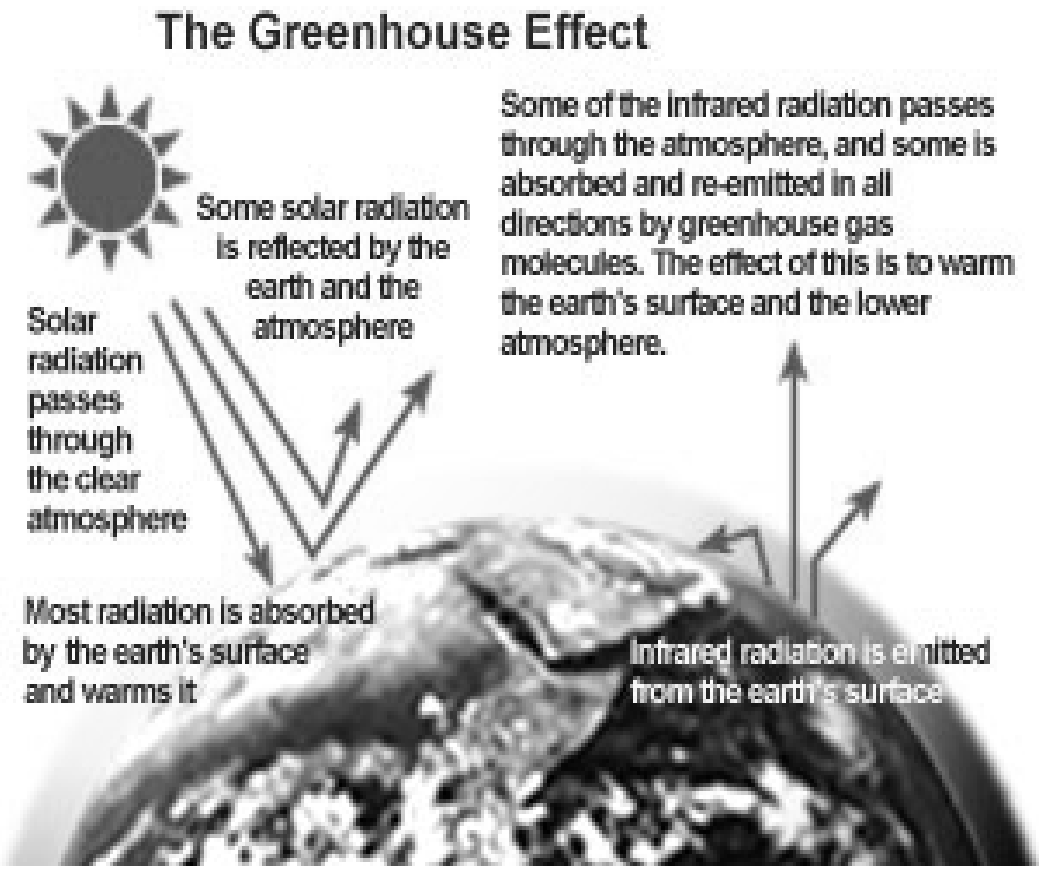
Introduction to Global Warming

- The Earth's surface temperature has risen by about 1 deg. F. in the past century
- Strong evidence that warming is attributable to human activities include;
- Loss of polar ice sheet
- Global sea level increase
- Plants and animals changing range and behavior in response to global shifts



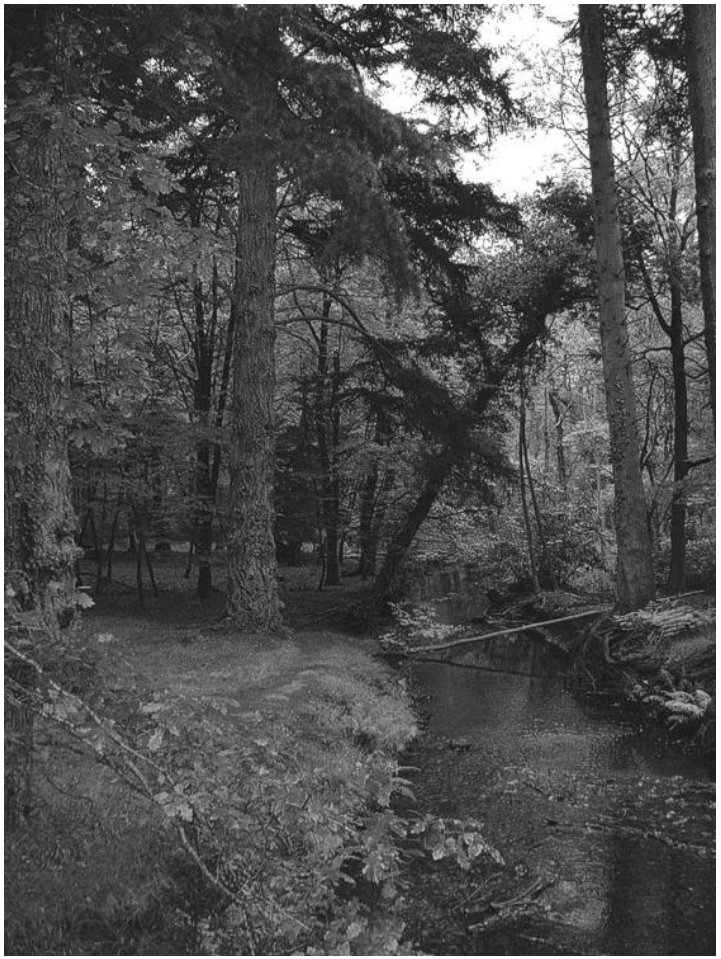
Our Changing Atmosphere

- Energy from the sun drives the earth's climate
- Greenhouse effect maintains livable temperature
- Generally in balance
- Problems arise when concentrations increase



Our Changing Atmosphere

- Plant respiraton and the decomposition of organic matter emit approximately 10 times the amount of co2 than human output
- However, this amount is balanced by the intake of co2 by terrestial vegetation and oceans
- The amount was always in balance



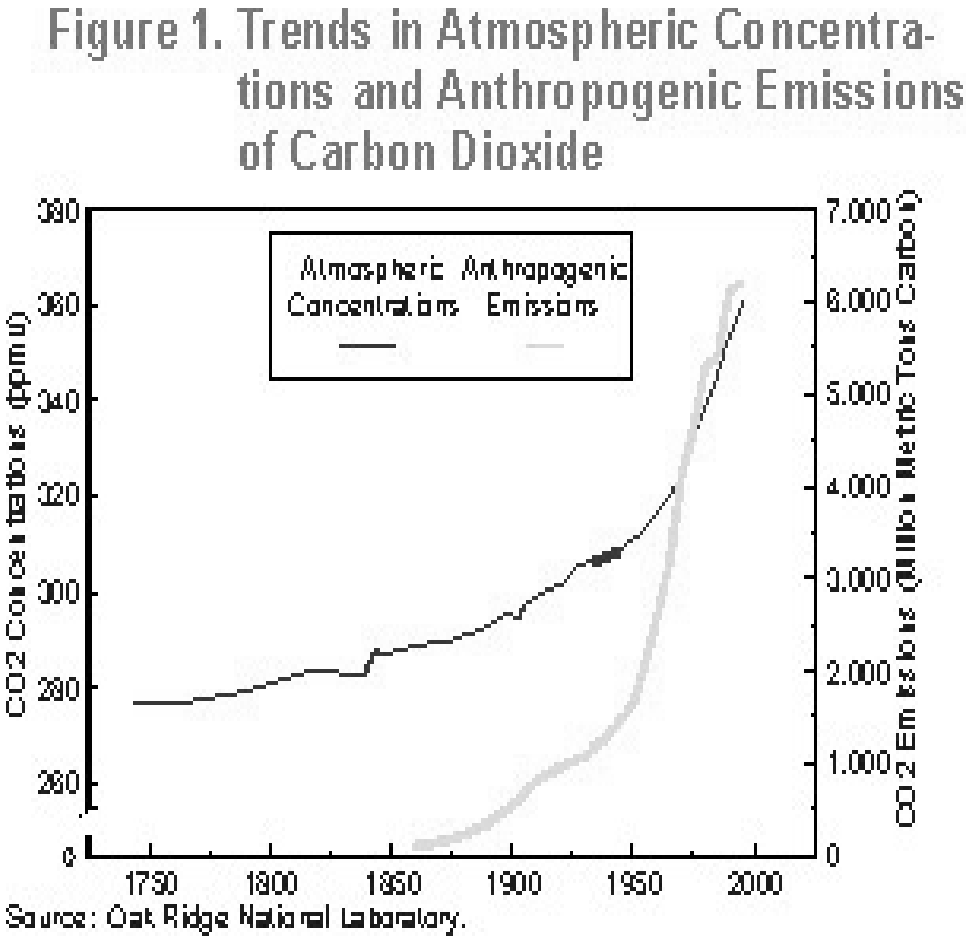
Our Changing Atmosphere

- Humans are emitting more greenhouse gases into the atmosphere
- Cars, trucks, home and business heating, and power factories are responsible for about 98% of US carbon dioxide emissions and 18% of nitrous oxide missions.

Our Changing Atmosphere

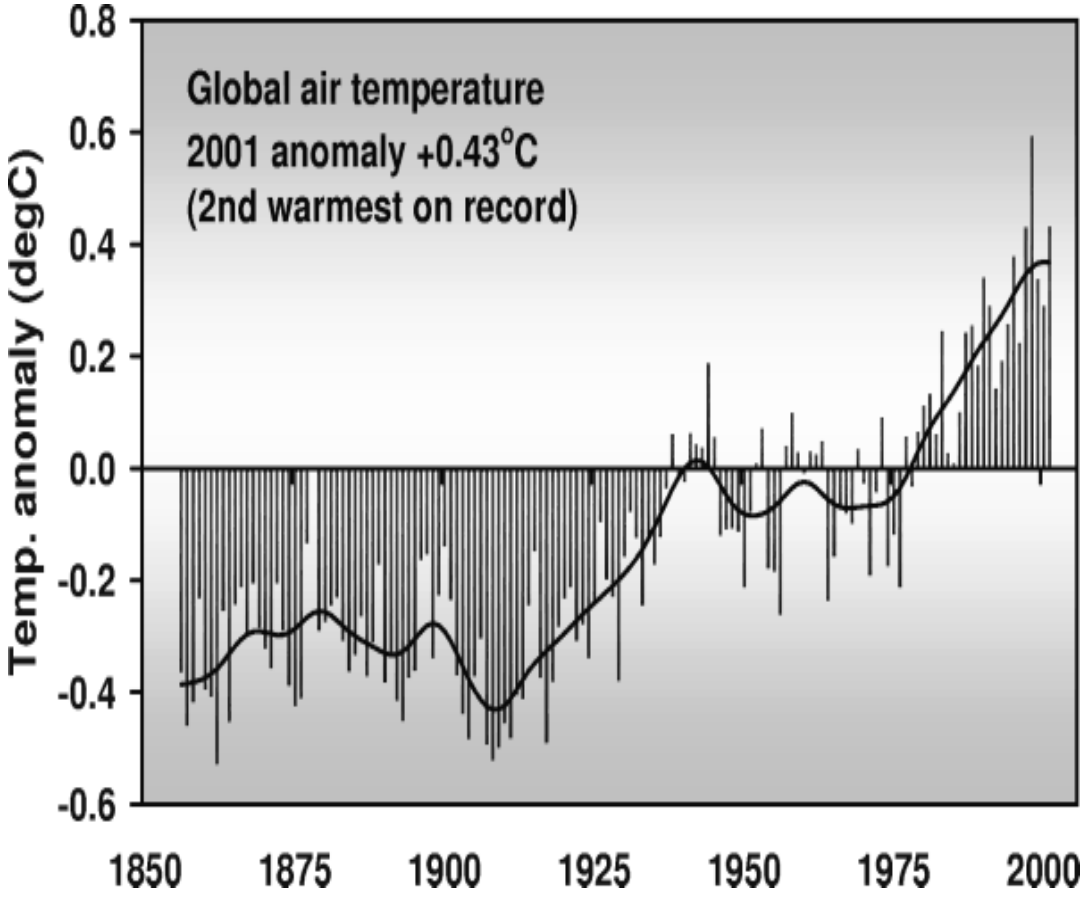
- Since the industrial revolution, greenhouse gases have increased by;

- Carbon Dioxide 30%
- Methane 100%
- Nitrous Oxide 15%



Our Changing Climate

- Global mean surface temperatures have increased 0.5-1.0 deg F since late 19th century
- The 20th century's 10 warmest years have occurred in the last 15 years of the century

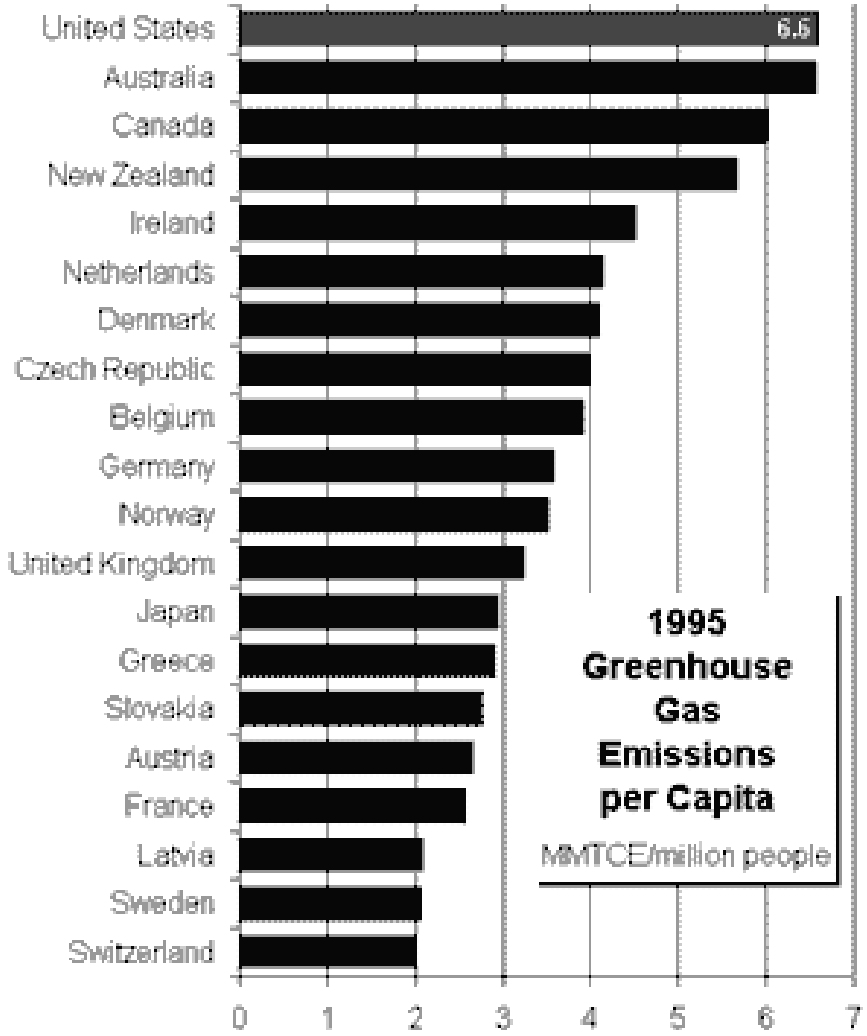


Our Changing Climate

- Warmest Years on Record
  - 1981
  - 1983
  - 1987
  - 1988
  - 1989
  - 1990
  - 1991
  - 1994
  - 1995
  - 1996
  - 1997
  - 1998
  - 1999
  - 2000
  - 2001

Our Changing Climate

- Emissions per American have increased about 3.4% between 1990 and 1997
- Most of these emissions, about 82%, are from burning fossil fuels to generate electricity and power our cars
- Remaining emissions are from methane from wastes in our landfills, raising livestock, natural gas pipelines, and coal



Uncertainties

What Is Known For Certain

- Human activities are changing the composition of the atmosphere
- Carbon Dioxide, Methane, and Nitrous Oxide have increased as a result of human activities
- Greenhouse gases trap heat in the earth's atmosphere and tend to warm the planet
- The key greenhouse gases emitted by human activities remain in the atmosphere for decades to centuries
- A warming trend of about 1 deg. F has been recorded since the late 19th century

Uncertainties

What Is Likely, But Not Certain

- What extent has the human-induced accumulation of greenhouse gases are responsible for the global warming trend
- For instance, scientific understanding of other factors are not know, such as natural climatic variations, changes in the sun's energy, and the cooling effects of pollutant aerosols is incomplete

Uncertainties

What Are The Big Unknowns

- Projecting the impacts to Health, agriculture, water resources, forests, wildlife and coastal areas in regional areas is very difficult
- Large–scale areas are more suited to global warming computer models
- Links to Global Warming and El Nino

Uncertainties

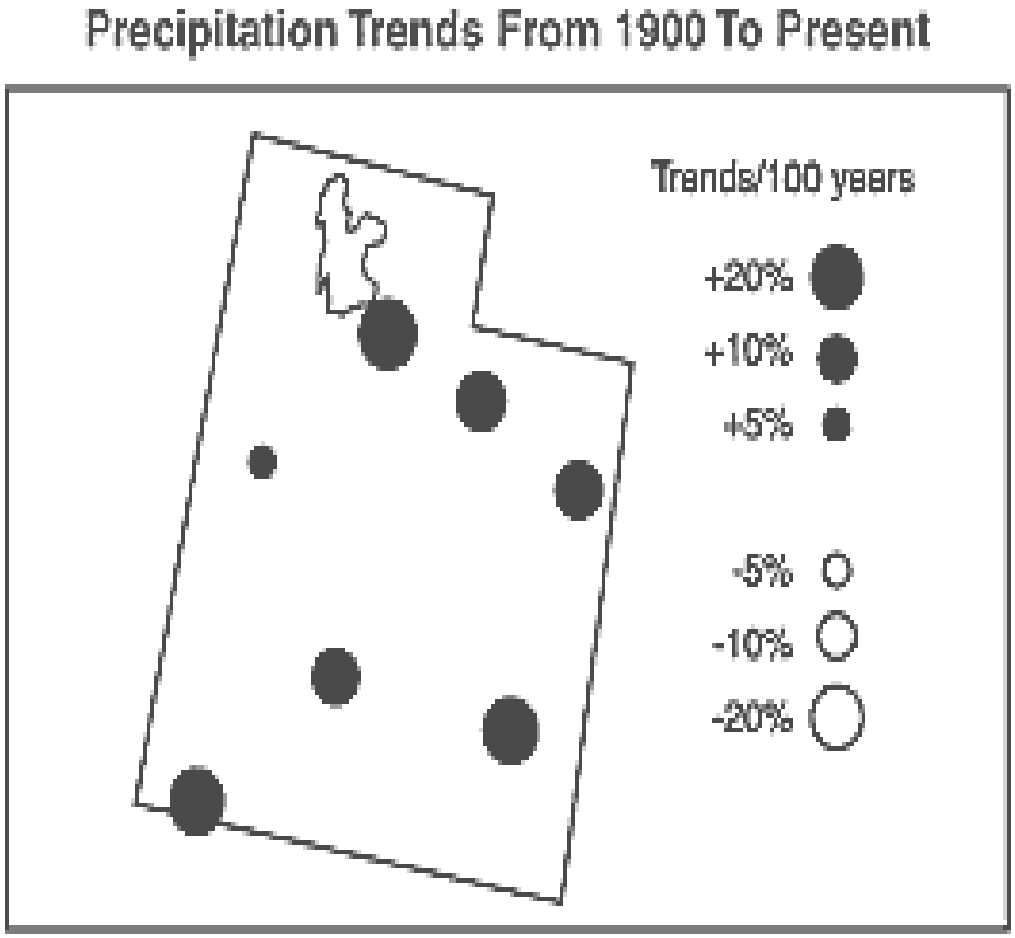
What Are the Big Unknowns Contd…

- How much warming will occur?
- How fast will this warming occur?
- What are the potential adverse and beneficial effects?

- These uncertainties will be with us for some time, perhaps decades

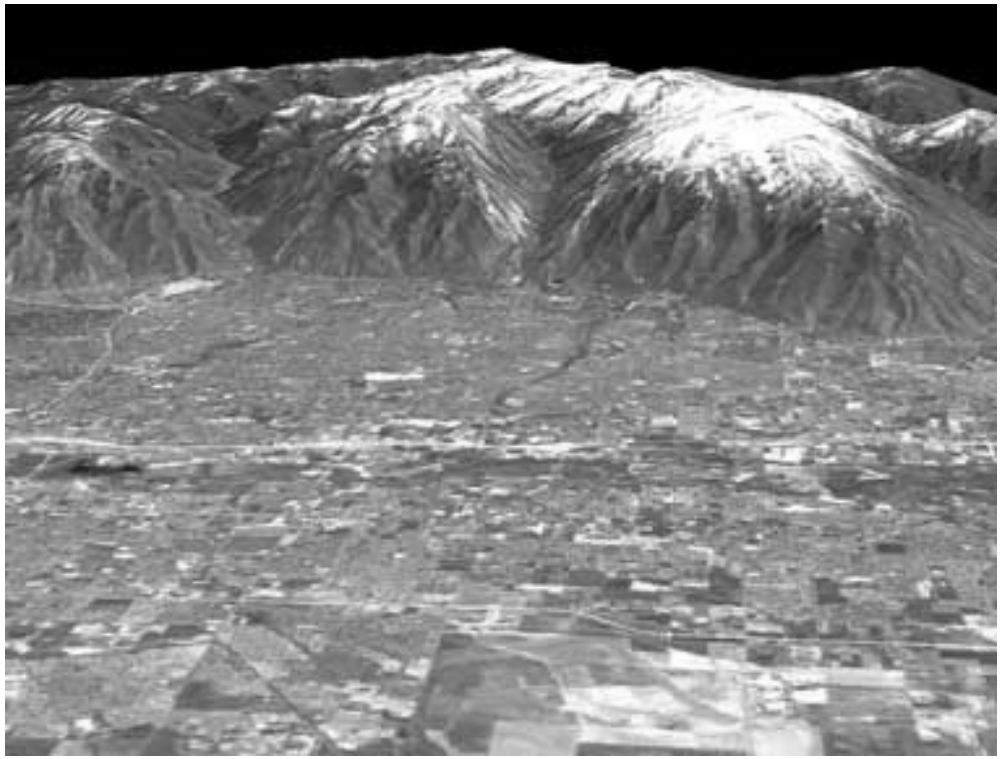
Local Climate Changes in Utah

- Over the past century, temperature in Logan Utah has increased by 1.4 deg. F.
- Precipitation has increased by up to 20% in many parts of the state
- These past trends may or may not continue into the future



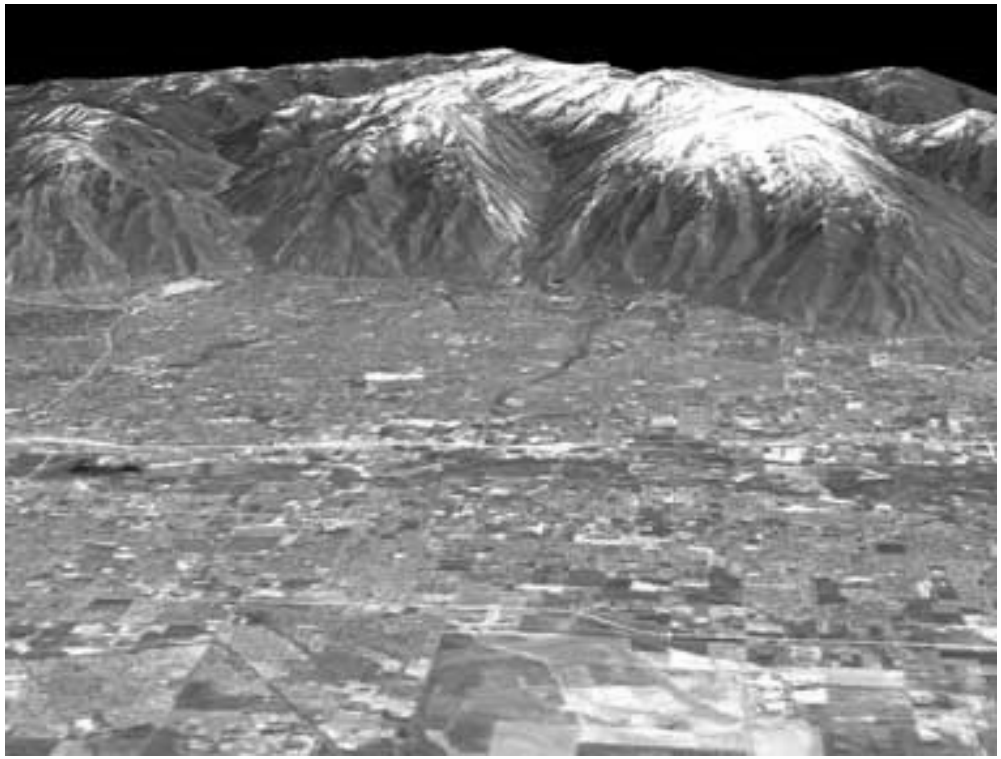
Possible Water Supply Scenarios

- A warmer climate could result in less winter snowfall, more winter rain, and faster, earlier spring snowmelt runoff
- In the summer, without increases in rainfall of at least 15-20%, higher temperatures and increased evaporation could lower streamflows and lake levels



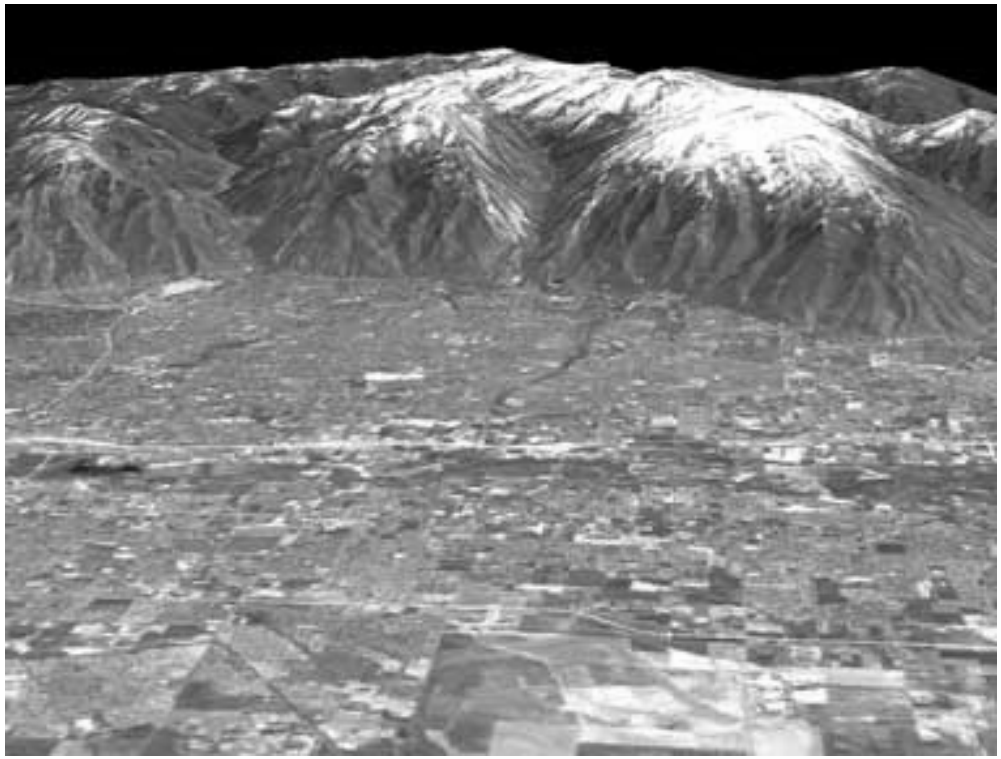
Possible Water Supply Scenarios

- Less spring and summer recharge also could lower groundwater levels
- Less water would be available to support irrigation, hydropower generation, public supply, fish and wildlife habitat, recreation and mining
- Complication of water rights and interstate compacts
- Ski industry may experience greater extremes



Possible Water Supply Scenarios

- Concerns about adequate water supplies could be exacerbated along the Wasatch Front
- Groundwater levels could be lowered further due to shortages in surface water storage
- Variations in snowpack accumulation rates and spring climate variability heighten the possibility of isolated river flooding
- Possibility of higher risk of debris flows



Agriculture

- Agriculture is strongly influenced by climatic conditions and water availability
- As climate warms, production patterns could shift northward and to higher elevations
- Increases in climate variability could make adaptation by farmers more difficult
- Warmer climate and less soil moisture may require additional irrigation

Agriculture

- Most studies have not fully accounted for changes in climate variability, water availability, crop pests, and changes in air pollution, such as ozone

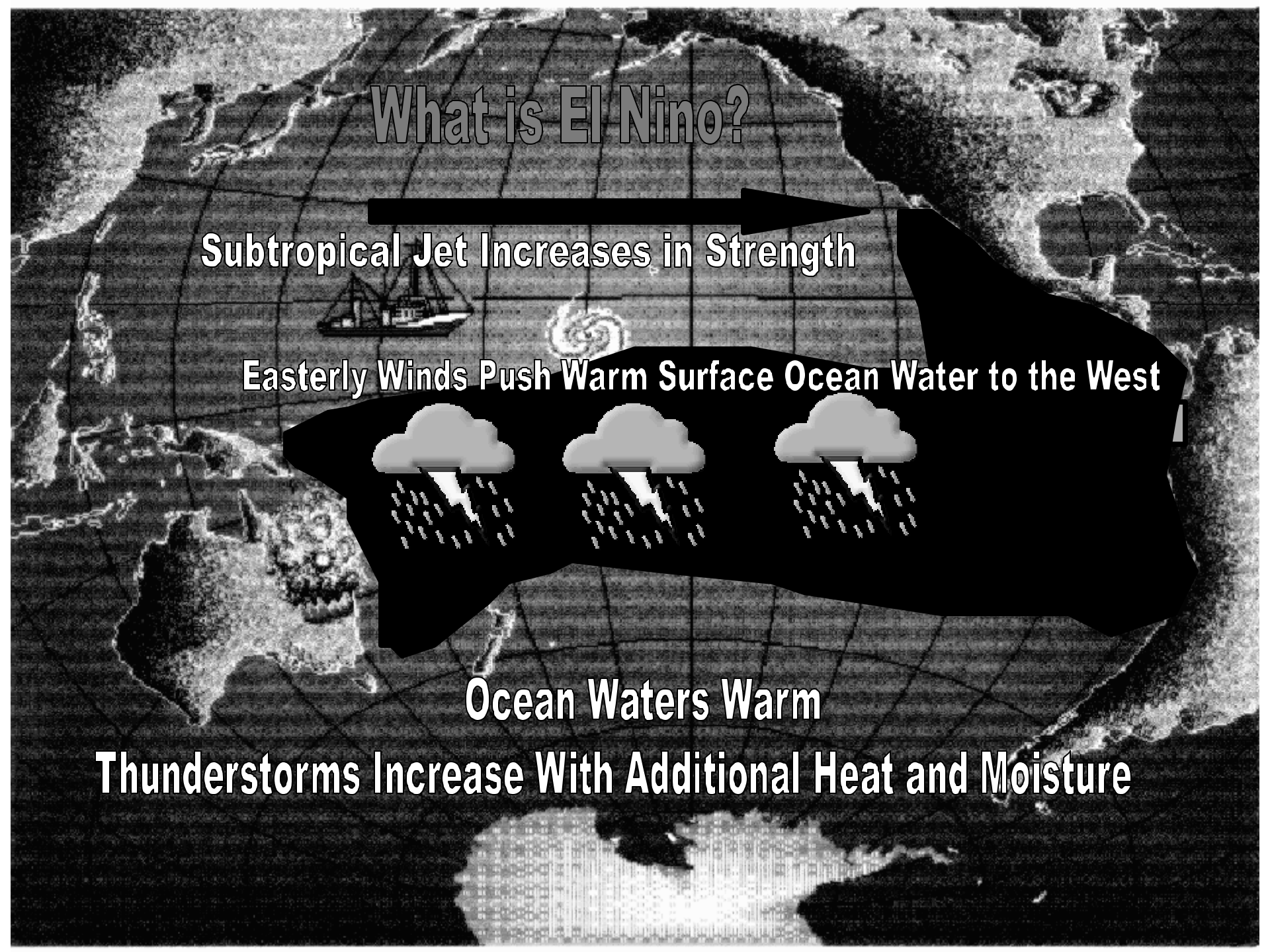
Forestry

- Depending on the amount of climate change, the extent of forested areas in Utah could change little or decline by as much as 15-30%
- Uncertainties depend on many factors, including whether soils become drier, and if so, how much drier
- Hotter, drier could increase frequency of wildfires
- Insect outbreaks could increase with warmer drier conditions

Short Term View of Utah's Climate

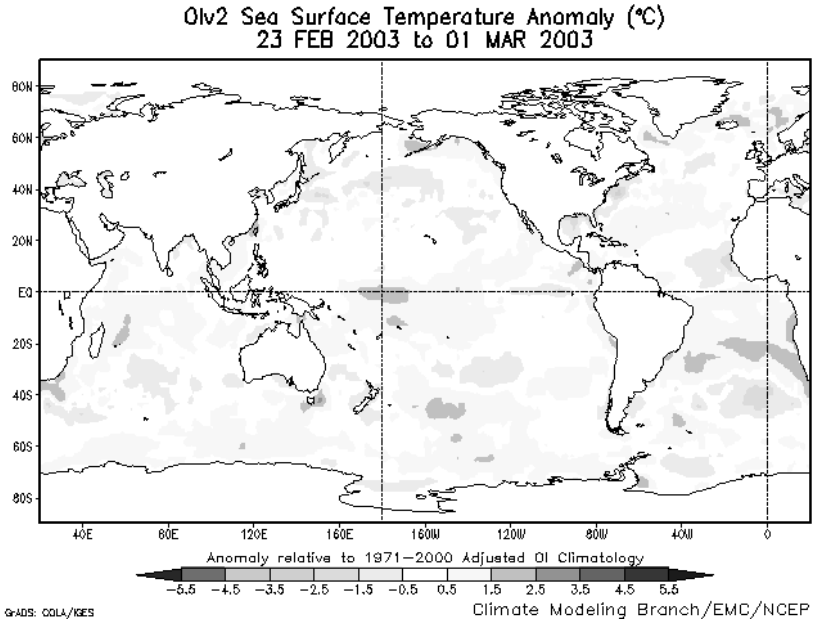
What is Happening Now

- El Nino
- La Nina


What is El Nino?
Subtropical Jet Increases in Strength
Easterly Winds Push Warm Surface Ocean Water to the West
Ocean Waters Warm
Thunderstorms Increase With Additional Heat and Moisture

Current El Nino Anomalies

- El Nino is currently in mature phase with anomaly at 1.0 – 1.5 degrees
- Continues to weaken as winter progresses
- Signature not that strong



Why are we still dry?

- 2003 El Nino was mild event
- Ocean waters warmed near date line and did not extend across to South American Coast
- As a result, ridge of high pressure dominated Utah's early winter pattern

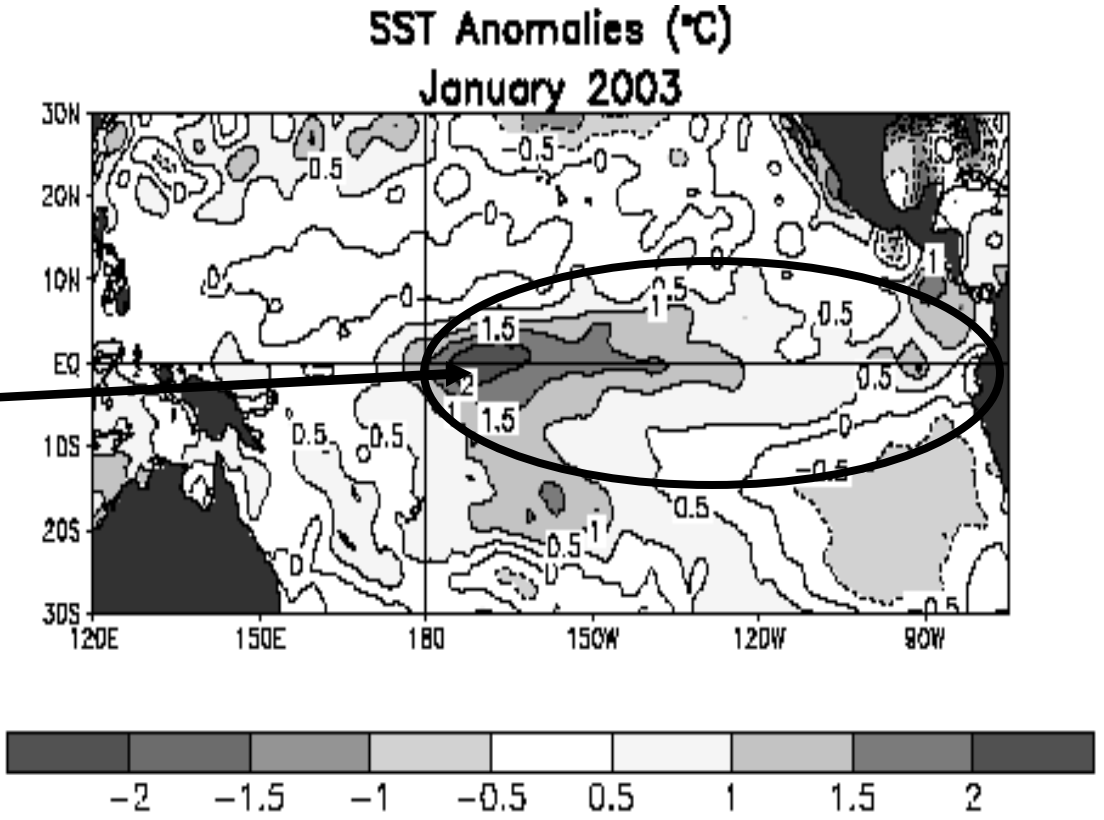
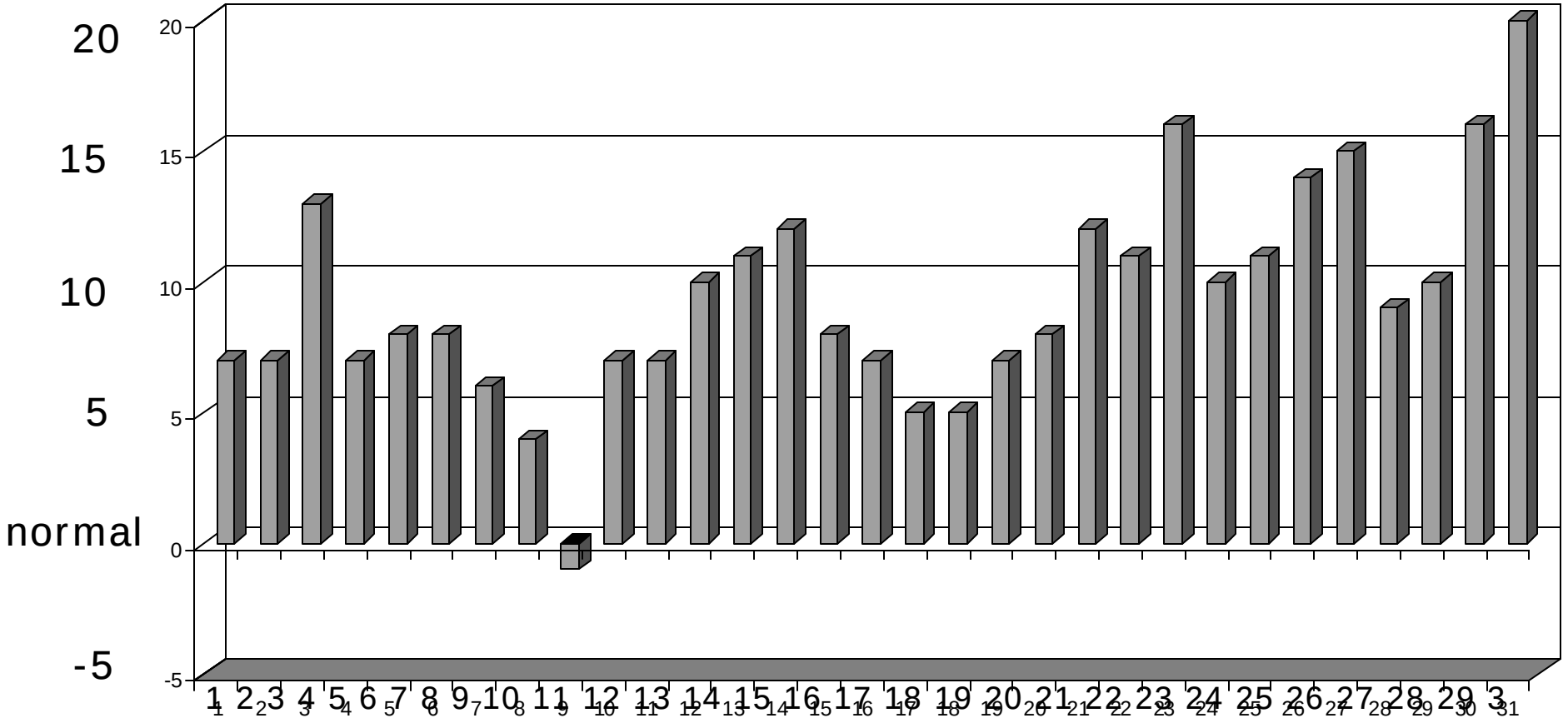
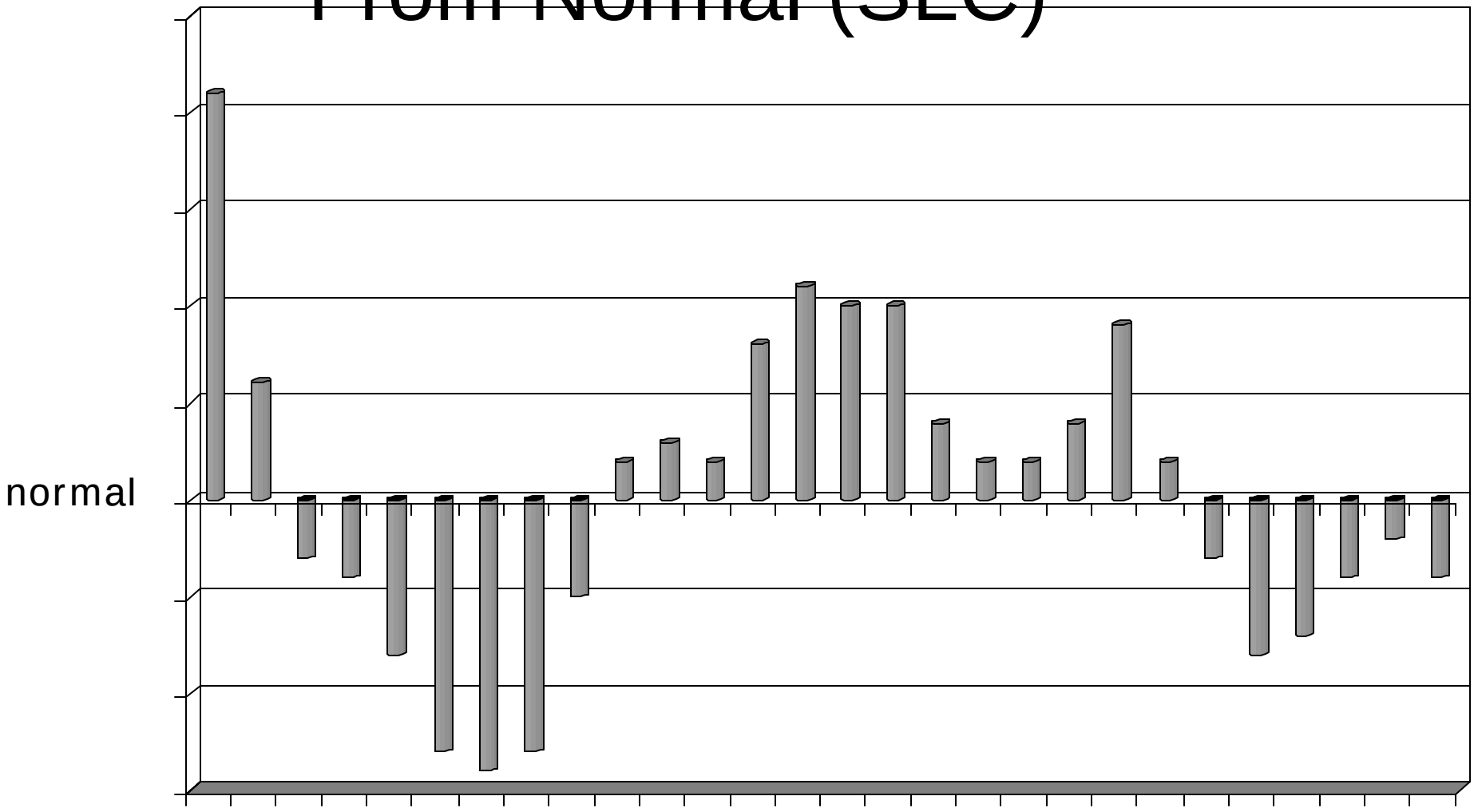


Figure 1. Sea surface temperature (SST) anomalies during January 2003. Departures from average (anomalies) are computed based on the 1971-2000 base period means. Units are °C. (Analysis obtained from the NCEP/Ocean Data Assimilation system that incorporates NOAA/PMEL TAO buoy data, NOAA/AVHRR satellite data and ships of opportunity.)

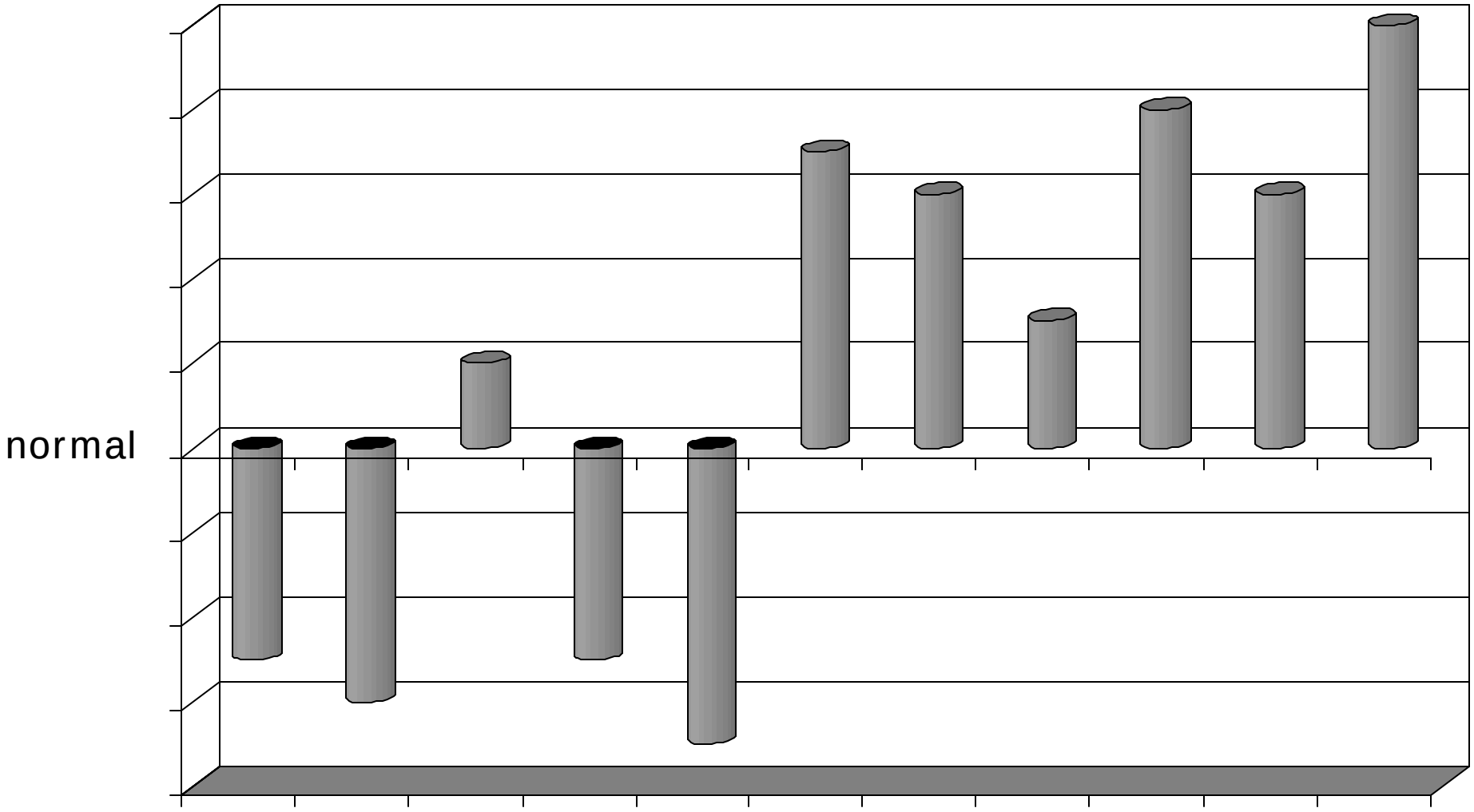
January Temperature Departure From Normal (SLC)



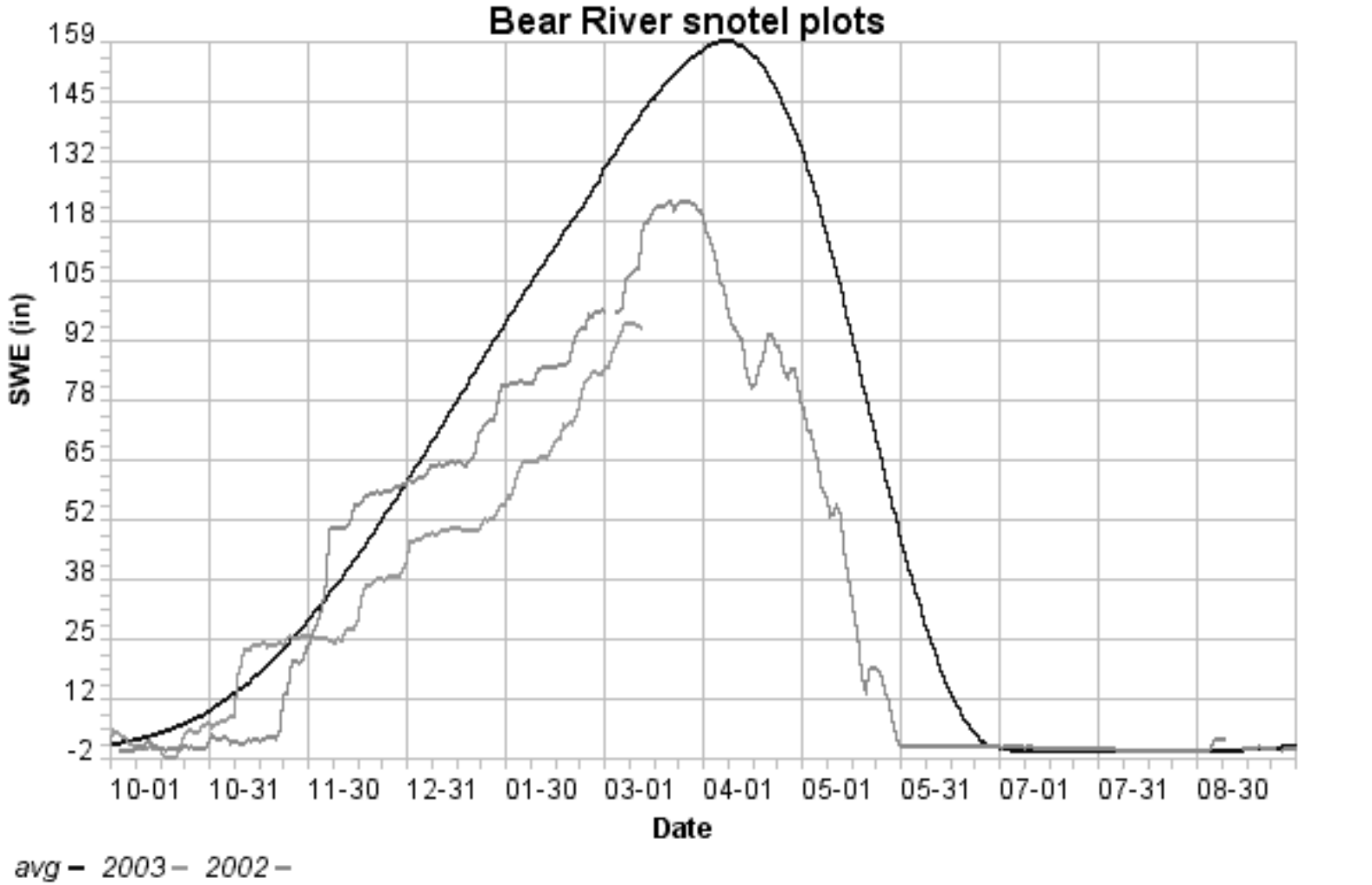
February Temperature Departure From Normal (SLC)



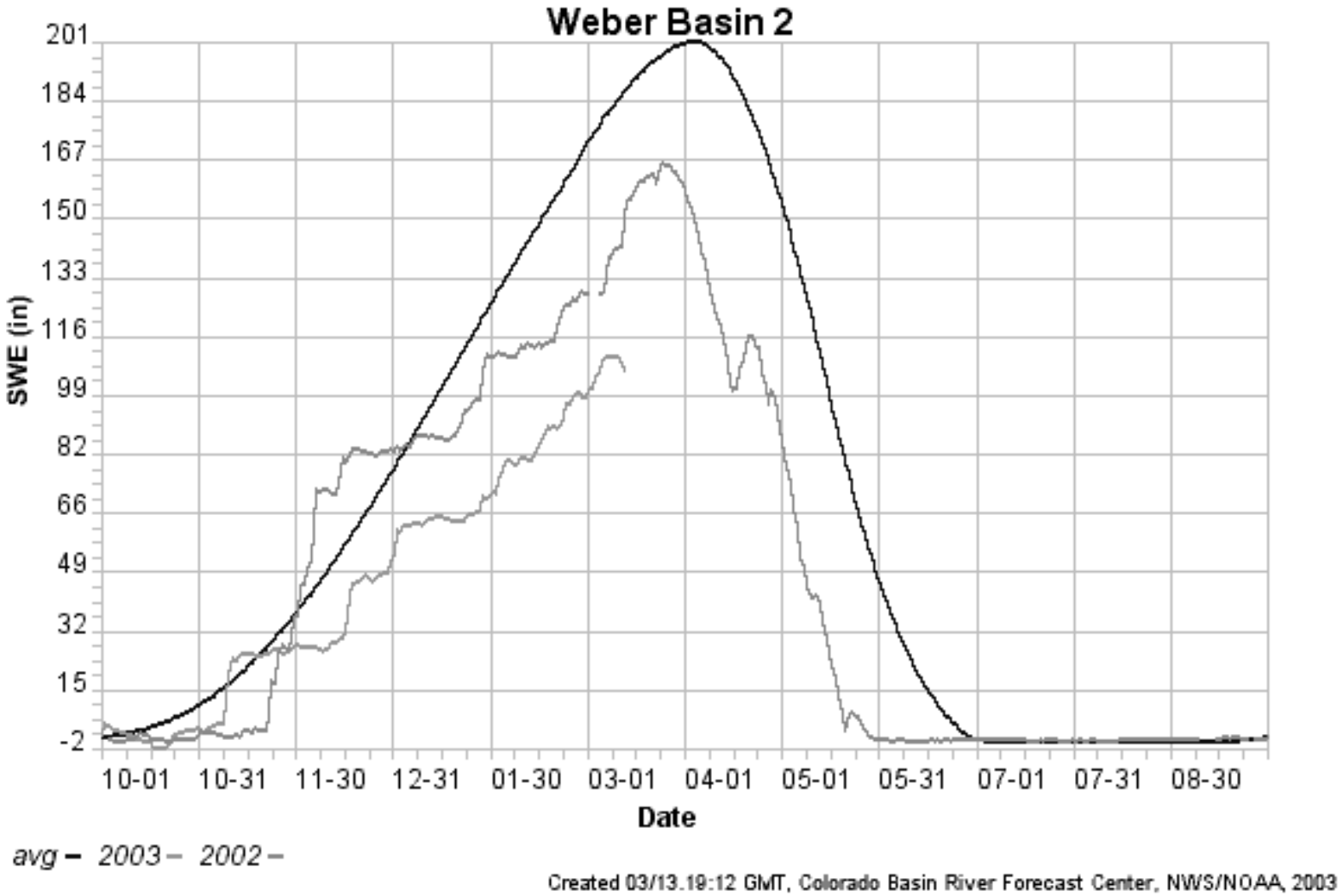
March Temperature Departure From Normal (SLC)



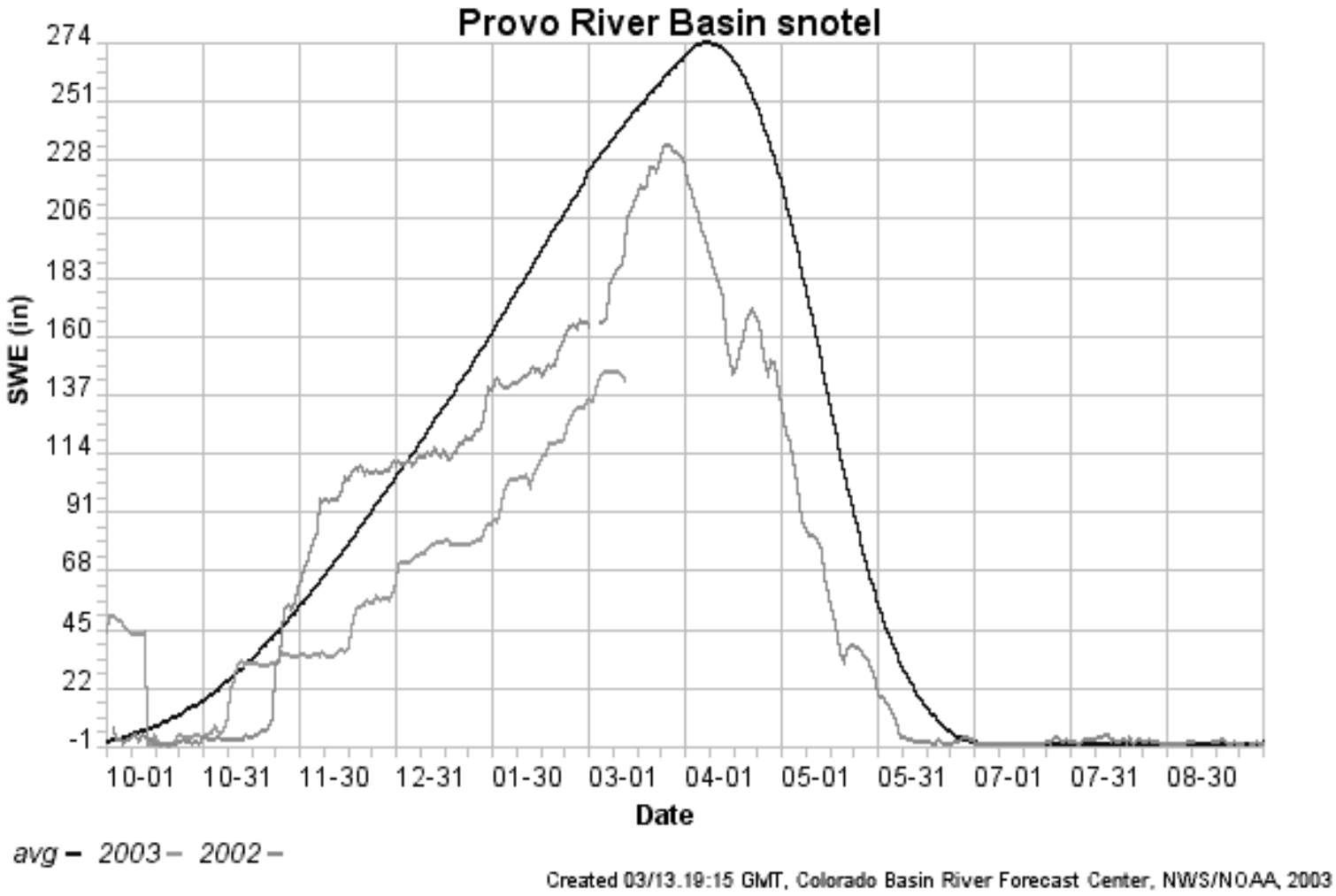
Bear River Basin Snow



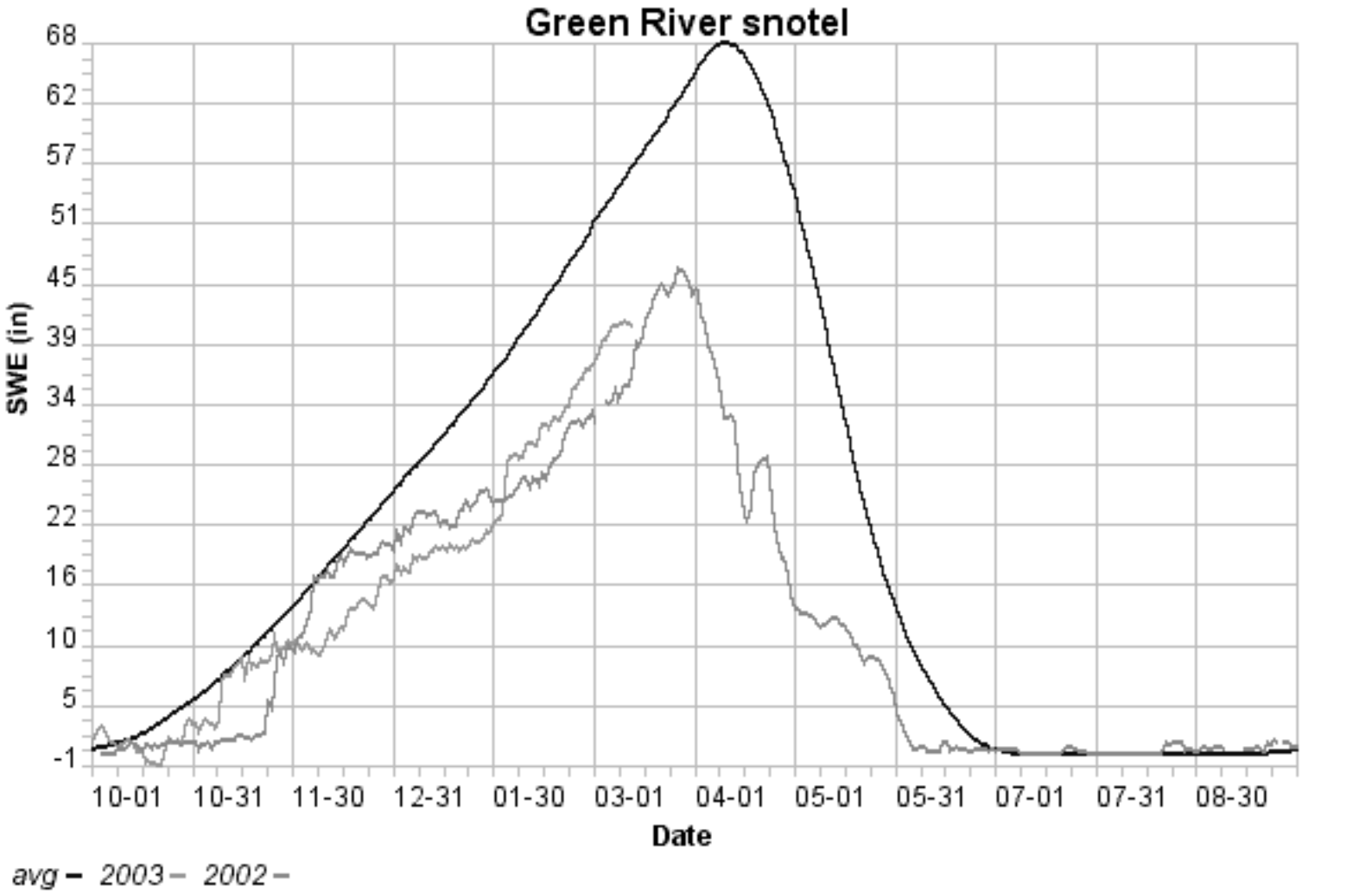
Weber River Basin Snow



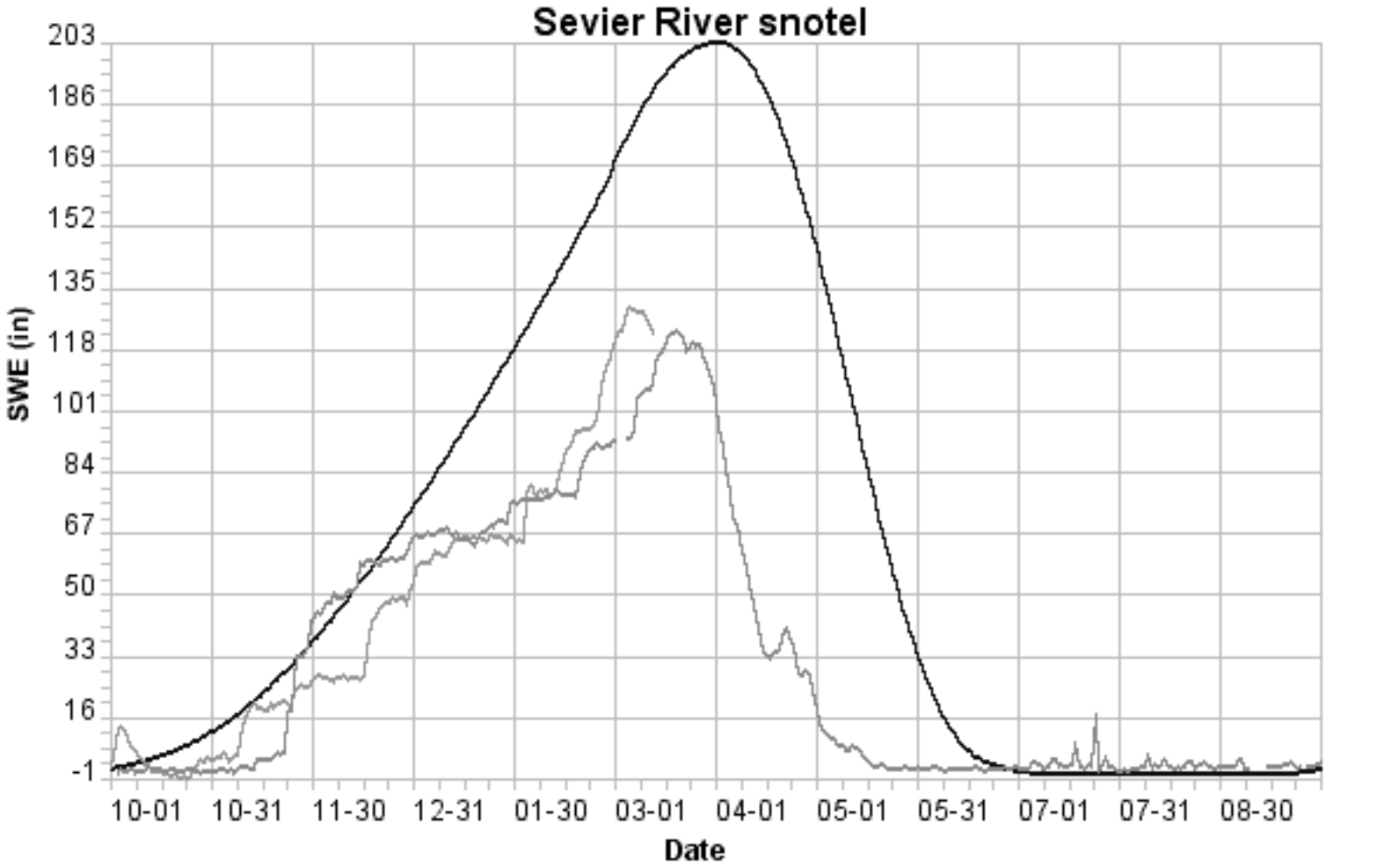
Provo River Basin Snow



Green River Basin Snow



Sevier River Basin Snow



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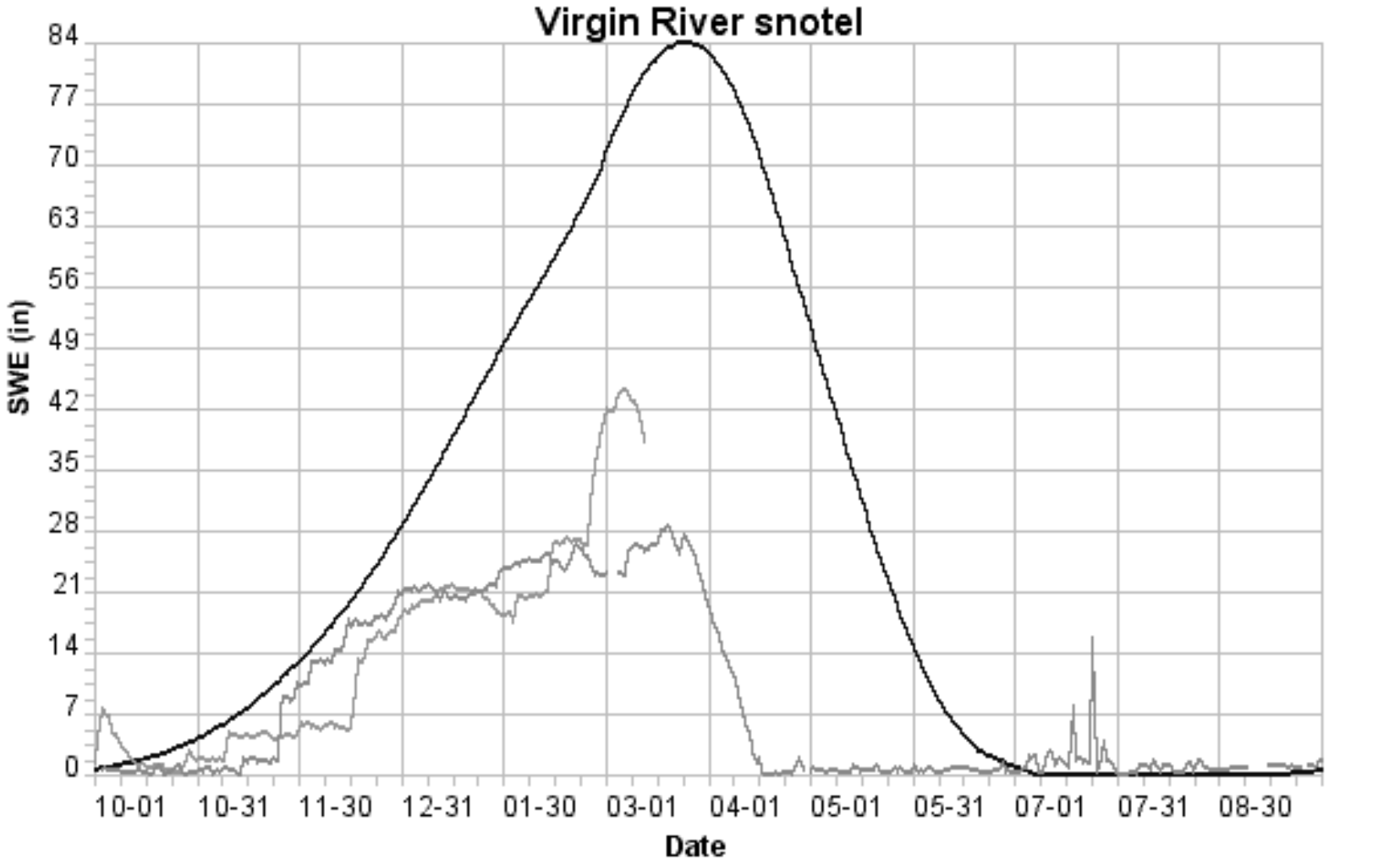
Virgin River Basin Snow



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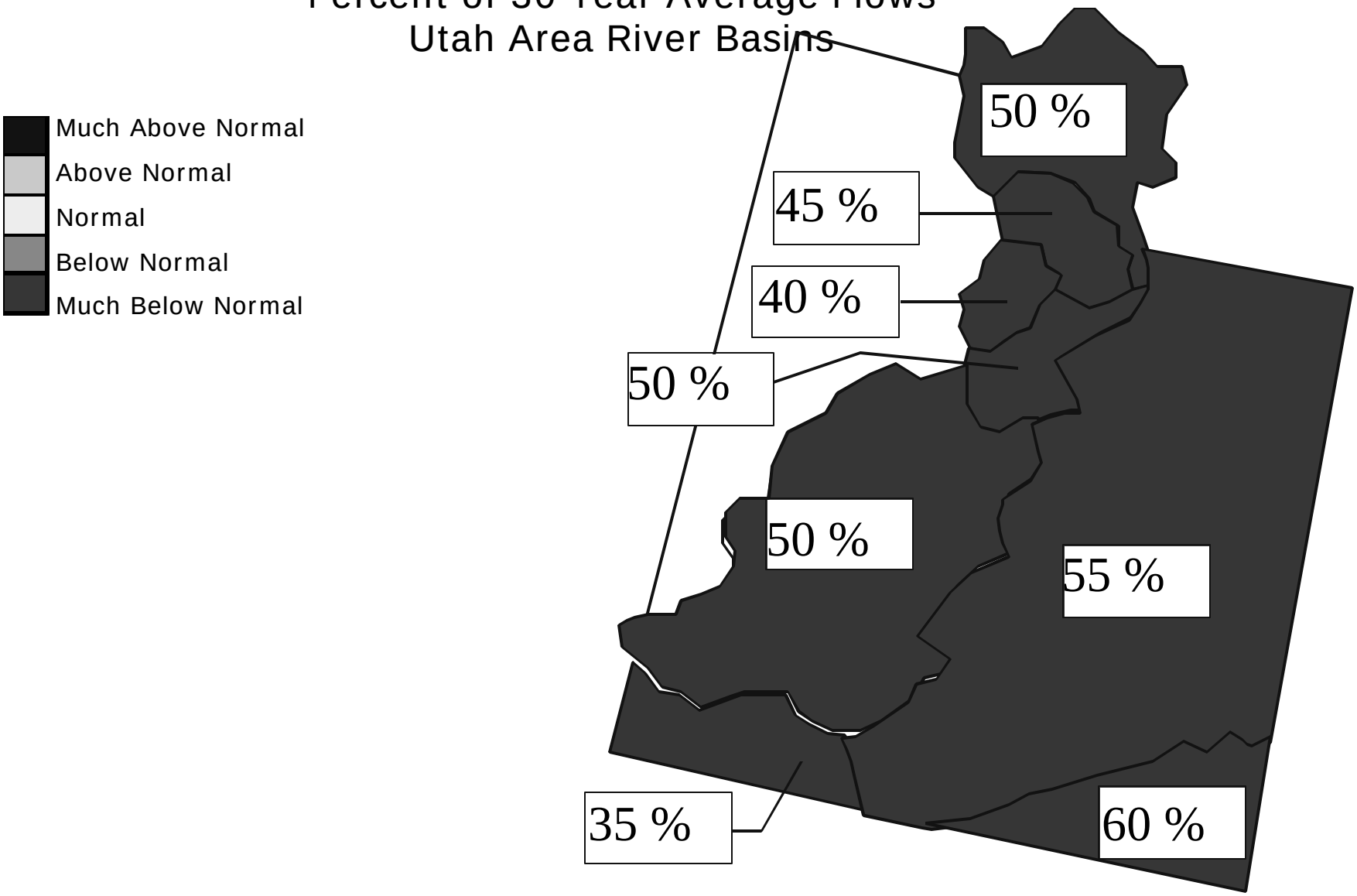
Forecasted Utah Spring Snowmelt Runoff Volume

March 1st 2003
April Through July Volume Forecast
Percent of 30 Year Average Flows
Utah Area River Basins



What's in store for the future?

- El Nino will be over by the summer
- El Nino not expected to return for another four years, possibly 2006
- Normal to dry conditions anticipated during the next period

Summary

- There are many unknowns to global warming
- There are some things that are known however
- The science points to continued warming
- Nothing is certain

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Additional Information

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